

of fecundation in the Floridæ differ widely from those hitherto known to occur in the Algæ. The structure of the organs, their mode of action, the period at which their functions are performed, and the effects which they produce present important differences related to those which distinguish the Floridæ from the other Hydrophytes. We no longer find in this case a direct action of the antherozoids upon the reproductive bodies: the operation is less simple, and in some respects presents some resemblance to that occurring in the higher plants; for we see in the same way a fecundation produced by immobile corpuscles upon an external organ, and having as its result the determination of a complete development of the apparatus of fructification.

IX.—*On the Ballast-Flora of the Coasts of Durham and Northumberland.* By JOHN HOGG, M.A., F.R.S., F.L.S. &c.\*

IN this short paper I beg to offer to botanists a few remarks on the plants which have been introduced with ballast by ships on the coasts of Durham and Northumberland.

This interesting subject has already received some attention from our practical and field-working botanists, namely the late Mr. Winch, the late Mr. Storey, the Rev. A. M. Norman, and Mr. M. A. Lawson, who have all published, in the 'Transactions of the Natural-History Society of Newcastle-on-Tyne,' and in those of the Naturalists' Field-Club, some lists of the *rare plants* which they found growing on the ballast-hills in their own vicinity. I have been able, from an acquaintance of some years with the ballast-districts of the county of Durham, to add several *rarer* species to those lists which were formed by the botanists whom I have already mentioned.

The extent of the two counties to which I have now limited myself comprises the sea-coasts and chiefly the banks of the rivers Tees, Wear, and Tyne: of the latter are the great ballast-deposits at Port Clarence and those at West Hartlepool, at East Hartlepool, and the embankment of the railway to the north of the latter town, the mounds of ballast at Seaham, at Sunderland, and near Wearmouth, as well as those at South and North Shields, and others along the Tyne nearer to Newcastle.

In the following lists of species I shall only divide them into *two* heads or divisions, viz., the first, those plants which are *exotics* or foreign to our island, and, the second, those more scarce indigenous and naturalized plants of Great Britain which were rarely seen, if not entirely unknown, in the before-named portions of England.

\* Communicated by the Author, having been read before the Section Biology at the British Association Meeting, held at Nottingham, August 28, 1866.

I. Plants which are *exotics*, or foreign to our island.

1st. Mr. Winch has given the annexed catalogue of forty-seven "Exotic Plants gathered on the Ballast-hills by the shores of the rivers Tyne and Wear:—"—

Blitum virgatum.	Lavatera trimestris.
Phalaris paradoxa.	Pisum Ochrus.
Bromus Madritensis.	Ornithopus compressus.
Convolvulus tricolor.	Echium Italicum.
Hyoscyamus albus.	Scorpiurus vermiculatus.
— aureus.	Vicia Benghalensis.
Solanum Lycopersicum.	— cordifolia.
Tordylium Syriacum.	Trifolium Indicum.
Cuminum Cyminum.	— Messanense.
Apium Petroselinum.	— elegans.
Reseda odorata.	Medicago prostrata.
— fruticulosa.	— coronata.
— alba.	— rigidula.
Euphorbia tithymaloides.	Scolymus maculatus.
— spinosa.	Chrysanthemum Italicum.
Mesembryanthemum crystallinum.	Anthemis tomentosa.
— falcatum.	— mixta.
— glomeratum.	— Valentina.
Argemone Mexicana.	Centaurea Galactites.
Nigella arvensis.	Calendula officinalis.
— Damascena.	Cannabis sativa.
Ranunculus muricatus.	Atriplex hortensis.
Lepidium sativum.	Salix acutifolia.
Alyssum incanum.	

2nd. Mr. Norman's foreign plants which are not included in Mr. Winch's catalogue are\* :—

Fumaria micrantha.	Polygonum rurivagum ( <i>Jordan</i> ).
Sinapis Schkuhriana ( <i>Reich.</i> ).	East Hartlepool.
Melilotus leucantha.	— microspermum ( <i>Jordan</i> ).
Petroselinum sativum ( <i>Hoffm.</i> ).	Stockton and Seaham.
	— arenastrum ( <i>Jor.</i> ). Seaham.

3rd. Mr. Lawson's foreign plants which are not given in either Mr. Winch's or Mr. Norman's lists are only from the ballast of the two Hartlepoons :—

Cheiranthus incanus.	Centaurea orientalis.
Hesperis matronalis.	Sclerochloa dura.
Coronilla varia.	Zea Mays.
Galega officinalis.	Eschscholtzia Californica.
Gypsophila paniculata.	Gazania splendens.

4th. The foreign plants which I have noticed are :—

Scolymus maculatus.	North of Old Hartlepool.
Iberis umbellata.	Port Clarence.

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\* I think it unnecessary to repeat in these lists many other species that generally occur in *all* the ballast-mounds, or those exotic plants which have been already given.

*Astragalus*. (A beautiful species, on the sides of the railway south of Seaton, where it has grown for many years, and perfects its seeds. It probably came from Spain or Portugal.)

*Blitum virgatum*. West Hartlepool.

*Trifolium Michelianum* (*Savi*). West Hartlepool.

*Galega officinalis*. From Spain.

*Coronilla varia*. Southern Europe.

*Calendula officinalis*. Port Clarence.

*Lepidium Draba*. West Hartlepool.

*Centaurea orientalis*. West Hartlepool.

II. *Rare plants, native or naturalized, which were imported with ballast.*

1st. Species enumerated by Mr. Winch :—

<i>Erigeron Canadense</i> .	<i>Enothera biennis</i> .
<i>Eryngium campestre</i> .	<i>Centaurea Jacea</i> .
<i>Datura Stramonium</i> .	<i>Linum usitatissimum</i> .
<i>Anchusa officinalis</i> .	<i>Borago officinalis</i> .
<i>Sinapis muralis</i> .	<i>Papaver somniferum</i> .
<i>Senecio viscosus</i> .	<i>Chærophyllum sativum</i> .
<i>Panicum viride</i> .	<i>Digitaria sanguinalis</i> .
— <i>verticillatum</i> .	<i>Polypogon Monspeliensis</i> .
<i>Solanum nigrum</i> .	<i>Anethum Fœniculum</i> .
<i>Centaurea Calcitrapa</i> .	<i>Teucrium Chamædrys</i> .
<i>Geranium rotundifolium</i> .	<i>Bromus diandrus</i> .
— <i>Pyrenaicum</i> .	<i>Glaucium luteum</i> .
<i>Cynosurus echinatus</i> .	<i>Coriandrum sativum</i> .
<i>Phalaris Canariensis</i> .	<i>Anagallis cærulea</i> .
<i>Clematis Vitalba</i> .	<i>Ranunculus hirsutus</i> .
<i>Anthemis maritima</i> .	<i>Hydrocharis Morsus-ranæ</i> .

2nd. Additions found by Mr. Storey :—

<i>Medicago maculata</i> .	<i>Pastinaca sativa</i> .
<i>Glyceria rigida</i> .	<i>Dipsacus sylvestris</i> .
<i>Beta maritima</i> .	

3rd. Included in Mr. Norman's list are—

<i>Papaver hybridum</i> .	<i>Glyceria loliacea</i> .
— <i>dubium</i> .	<i>Lepidium ruderales</i> .
<i>Coronopus didymus</i> .	<i>Sisymbrium Sophia</i> .
— <i>Ruellii</i> .	<i>Sinapis tenuifolia</i> .
<i>Thlaspi arvense</i> .	<i>Raphanus Raphanistrum</i> .
<i>Nasturtium sylvestre</i> .	<i>Saponaria officinalis</i> .
— <i>terrestre</i> .	<i>Medicago sativa</i> .
— <i>amphibium</i> .	— <i>minima</i> .
<i>Reseda lutea</i> .	<i>Onobrychis sativa</i> .
<i>Arenaria Lloydii</i> .	<i>Cichorium Intybus</i> .
<i>Trifolium arvense</i> .	<i>Artemisia campestris</i> .
— <i>scabrum</i> .	<i>Echium vulgare</i> .
<i>Oenanthe crocata</i> .	<i>Chenopodium rubrum</i> .
<i>Carduus tenuiflorus</i> .	— <i>glaucum</i> .
<i>Senecio sylvaticus</i> .	<i>Mercurialis annua</i> .
<i>Myosotis versicolor</i> .	<i>Agrostis Spica-venti</i> .
<i>Atriplex arenaria</i> .	<i>Lepturus filiformis</i> .
— <i>Babingtonii</i> .	

4th. Species discovered by Mr. M. A. Lawson :—

Delphinium Consolida.	Salvia Verbenaca.
Erysimum cheiranthoides.	Euphorbia amygdaloides.
Brassica oleracea.	Eryngium maritimum.
Lepidium campestre.	Veronica Buxbaumii.
Silene maritima.	Thymus Acinos.
— Otites.	Parietaria diffusa.
Spartium scoparium.	Epilobium angustifolium.
Sisymbrium Irio.	Erigeron acre.
— Monense.	Anthemis tinctoria.
Camelina sativa.	Symphytum officinale.
Raphanus maritimus.	— —, <i>var. patens.</i>
Erodium moschatum.	Antirrhinum spurium.
Linum angustifolium.	— minus.
Medicago falcata.	— Linaria.
Lathyrus sylvestris.	Sambucus Ebulus.
Chrysanthemum segetum.	Centaurea solstitialis.
Verbascum Thapsus.	Polygonum Fagopyrum.
— Blattaria.	Poa maritima.
— nigrum.	

5th. The last list contains the chief indigenous or naturalized plants which I have found on the ballast in different places, during several years. Some of the species were seldom seen, and others never occurred, in the districts already indicated, before the deposits of the shingle or ballast were formed.

Artemisia campestris.	Galium cinereum.
— cærulescens.	Borago officinalis.
Carduus eriophorus.	Phalaris Canariensis.
— acanthoides.	Camelina sativa.
Cichorium Intybus.	Tragopogon major.
Eryngium campestre.	Marrubium vulgare.
Trifolium ochroleucum.	Pyrethrum inodorum, <i>var. flore pleno.</i>
— arvense.	Scleranthus annuus.
Alyssum maritimum.	Medicago sativa.
Onopordum Acanthium.	Trifolium scabrum.
Papaver somniferum.	Melilotus leucantha.
Senecio sylvaticus.	Solanum nigrum.
Glyceria rigida.	Nasturtium sylvestre.
Chenopodium viride.	Glaucium luteum.
Galium Mollugo.	Raphanus Raphanistrum.
Vicia lævigata.	Senecio viscosus.
— Bobartii.	Centaurea Calcitrapa.
Hedysarum Onobrychis.	Sinapis tenuifolia.
Antirrhinum minus.	— muralis.
Astragalus glycyphyllus.	Antirrhinum Linaria.
Mercurialis annua.	— Elatine.
Lepidium campestre.	Lepidium ruderales.
Reseda lutea.	Melilotus officinalis.
Anthyllis vulneraria.	— arvensis.
Echium vulgare.	Trifolium repens, <i>var. foliaceum.</i>
Pastinaca sativa.	Cochlearia Armoracia.
Convolvulus arvensis.	Reseda lutea.
Beta maritima.	Erigeron Canadense.
Picris echioides.	Brassica oleracea.
Ononis arvensis, <i>var. flore albo.</i>	Delphinium Consolida.

The plant which I have identified with *Trifolium Michelianum* (Savi), and which I found this summer at West Hartlepool, is very handsome, and in some respects resembles *T. elegans* of the same author, which Mr. Winch had observed many years ago on the Tyne ballast. My species differs, however, from *T. elegans* (Savi) by its stem being hollow, and by its *broad ovate* stipules. It is a large and strong plant, a native of Italy, and has most likely been brought with ballast from Leghorn; also *Galega officinalis*, an elegant plant with blue flowers, originally from Spain. A very pretty *variety* of *Ononis arvensis*, with a *snow-white* flower, I observed in the same place: it has a smaller standard-petal, and rounder than that of the common *pink Ononis*, without the small terminal point, slightly hairy and less keeled on the back. Also a curious *variety* of the common white clover, *Trifolium repens*, from the same ballast-heap, deserves notice: it may be termed var. *foliaceum*. From the specimens it will be seen that the segments of the calyx terminate in leaves with strong ribs and teeth, thus causing very much the appearance of *curled parsley*. This sort of clover is known to run into *varieties*. Withering mentions one as having "small heads of leaves growing out of the flowers" (vol. iii. p. 633, 4th edit.), and Dr. Johnston, in his 'Flora of Berwick,' vol. i. p. 162, describes another variety, which he observed on Holy Island. "The flowers," he says, "are supported on rather long stalks; the calyx has six leaf-like cut segments, while the style is dilated into a large ovate leaf, toothed on the margins." And Mr. Norman mentions another "form of the *Dutch clover*, in which the place of petals is supplied by little leaves;" this he noticed at Seaham. Mine, however, seems to differ from the other three abnormal forms chiefly in having the sepals fully transformed into leaves; and I take it to be the var. *phyllanthum* of Seringe, which is found at Geneva and Berne.

The ballast of the localities named being very commonly chalk with flints, we find many plants which grow naturally in that and other calcareous formations. But several orders of plants are without one representative: for example, there are no Orchideæ, not even the *Ophrys muscifera*, *O. apifera*, *O. aranifera*, *Herminium Monorchis*, *Orchis militaris*, *O. fusca*, and others which rejoice in a chalky soil. Nor are there any Saxifragæ, or Seduns, except *S. acre*.

No *roses*\* have I met with, or *Rubi*, or Ranunculaceæ. Of the Umbelliferæ I have found several more exotic species; but they are difficult to determine, as well as more of the Cruciferæ

\* Mr. Winch only records one rose in his lists, which is *Rosa alba*. He found it "on the banks of the Tyne, below Bill Quay." As it is "a native of Germany and South Europe," it seems to me more probably to have been an outcast from some neighbouring garden.

and Compositæ: this is caused in a great degree by many of those plants being poor specimens, not in flower, and often dwarf and puny in their growth; besides, very many are foreign species.

It may be asked, do many of these ballast-plants continue to flourish in a naturalized condition for a long period? and have they spread in the vicinity or superseded the more common plants of the district?

To these questions I may reply that the more tender kinds flourish for two or three seasons, but are soon killed by the frost of a severe winter or the cutting east winds in spring. Several sorts have been carried to some distance from the coast by ballast taken for the repairs of the railways. *Antirrhinum*, *Linaria*, the *Meliloti*, the two species of *Sinapis* now named *Diplotaxis*, *Spartium scoparium*, *Anthyllis vulneraria*, *Senecio viscosus*, some other Compositæ, and Leguminosæ may be met with in spots where, some years ago, and before so many railways were finished, they did not occur at all. But I do not think that the ordinary plants of the district have as yet undergone any material decrease or any considerable change.

Mr. M. A. Lawson, a zealous and good botanist, who resides during a part of the year very near to the two Hartlepoons, and has had more frequent opportunities of examining the ballast species there than I have had, thus describes the appearance of *annuals* in the ballast when first deposited, and the succession of *perennials* after a brief period:—

“For a long time I have observed that after the ballast is first thrown out, it is covered almost solely with *annuals*; but in two or three years these *annuals* have either entirely disappeared, or else, from their scarceness, have become a very inconspicuous part of the flora, and a vast variety of *perennials* have sprung up in their place, which in their turn overrun the whole ground, and then gradually dwindle away to a most minute fraction of their former abundance, so that, even if there were no spot from which they had entirely disappeared, it might be reasonably supposed that they would in a few years, at the furthest, become extinct” (p. 304, Trans. T. N. F. Club, vol. v. part 4, 1863).

Between North Shields and Berwick-on-Tweed I believe there are no large ballast-heaps, since along the coast of Northumberland only two quays or shipping-places of any size exist, namely near Blyth and at Alnmouth, where, in fact, only coasting-vessels or ships of light tonnage resort. And I know little about what ballast-hills may have of late years been formed near the Tweed at Berwick, as I have not been there recently; but most assuredly there must be some such mounds, because the railway traffic and the increase of shipping in that port must have introduced much coal-refuse, shingle, or ballast.